The Solutions Network

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How to Optimize Your Building Controls

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Overview

- Systems and their capabilities
- Under-utilized features
- Issues – things that have not worked well
- Suggestions from the vendor's viewpoint

System Capabilities

- Key elements of a DDC control system
  - Building controls
    - Sensors, control loops, actuators
  - Globalized control
    - Collection of data from multiple controllers
    - Execution of global control algorithms
    - Instructions to controllers
  - Enterprise Level
    - Data collection and presentation
    - Points of human interaction

A Look Back

- At the building controls level, not a lot has changed over the past 15 to 20 years.
  - Application software has become more user friendly with graphical object based tools.
  - Communication speeds have increased
  - The introduction of open protocols has reduced the need for gateways
- The ability to execute sound process control exists!

A Look Back

- The ability to execute globalized control algorithms has been in place for some time.
  - Demand control, chiller plant optimization
  - Communication robustness has increased
  - Introduction of the IP level has expanded the reach of globalized algorithms
  - Application tools have become more user friendly

A Look Back

- The Enterprise Level of DDC systems has seen the most significant changes
  - The introduction of the IP layer
  - The introduction of Web Clients
  - The adoption of standard software platforms such as Sequel, Access, Excel
- The concept of “Open Systems” is just now moving from the marketing departments to the field environment.

Now

- The controls industry has in place the hardware and software platforms that allow facility owner/operators to execute very sophisticated and efficient programs for controlling their facilities.
- Incremental improvements in technology will continue to evolve but the key issues facing owner/operators are not related to current system capabilities.

Under-utilized Features

- Integration of the different building systems
  - Lighting
  - HVAC
  - Access
  - Energy Consumption
- System Optimization Concepts
- Data Management

Under-utilized Features

- System Optimization
  - This can vary from simple to complex.
  - If all of the terminals are in reheat, why are you delivering 55 F air?
  - If all of the terminals are controlling at less than 50% damper position, why is the static pressure set point at 1.5 in w.c.?
  - Rolling “soft” demand control can save dollars without the customer being aware. Why not?

Under-utilized Features

- Data collection and processing is not typically executed to the maximum advantage.
  - A DDC system can collect “a lot of data”
  - The typical manager has little time to review reams of data.
  - The data needs to be “processed” by the reporting features within the DDC system.
  - Program the system to give you your system’s “blood pressure”

Issues

- The acquisition process
- Personnel skills
- The commissioning process
- Continuous commissioning

The Acquisition Process

- The process is “broken”
  - Controls are a specialty and not just the last 10% of an HVAC project
  - If your consultant does not have the ability to design the control system without copying a vendor provided specification, you are on the road to marginal quality

The Process is Broken

- Vendor provided specifications seldom, if ever, emphasize commissioning and enforced quality control programs.
- Vendor provided specifications focus on unique features that are intended to drive competitor's costs up and produce an advantage.

The Process is Broken

- A specification must address commissioning issues and a well defined enforcement program for quality control
- All bidders have to understand the “standards” for quality and the impact if they do not deliver. If this is not communicated, quality does not have a chance.
- History is working against you!

Key Quality Issues

- Appropriate measurement devices
- The right controller for each application
  - One of the most common errors in control system design
  - Controllers fit into different categories and each category is intended for a particular range of application. Miss-application leads to poor control
  - Terminal equipment, small systems, built up systems

Key Quality Issues

- The communication media
  - Type
  - Speeds
  - Performance measurement
- You can not spend too much money on your "network"
  - Every vendor has specific standards for cable and installation requirements
  - Find out what they are and ensure they are met!

Key Quality Issues

- I/O performance & calibration
  - Know how to specify performance. It is more than the A/D or D/A converter
  - There is no such thing as a calibrated sensor installed out of the box
  - Who calibrates, how is it documented and how is the process validated?

Key Quality Issues

- Proportional Control Loops
  - The correct algorithm is important
    - Proportional for “slow” loops
    - P+I for moderate loops
    - Floating control for “fast” loops (pressure and flow)
  - Understand the limitations of the PID algorithm as it is applied to HVAC processes

Key Quality Issues

- Proportional Control Loops
  - PID is the most miss-understood algorithm in controls.
  - Precision control requires more than PID and is expensive.
- Loop tuning is important: who, when, how is it documented and how is it validated.

Key Quality Issues

- Functional testing of applications
  - Who writes them?
  - Who executes them?
  - How is the testing validated?
- Documentation of applications
- Timing/stability of applications
  - This is a tough one. It can only be done by reviewing the data and with thorough functional testing.

Key Quality Issues

- Parameter access: the usability of your system is “at risk” if you do not understand this issue and define requirements.
  - Can you calibrate from the HMI?
  - Can you tune from the HMI?
  - Can you adjust timing parameters from the HMI?
- Terminology: there is no controls dictionary
  - A good specification will define “everything”.

Key Quality Issues

- Alarm criteria
  - What and why
  - Access to setup
- Data collection
  - Permanent versus temporary
  - Memory space
  - Criteria

Key Quality Issues

- The Enterprise Level
  - Where are the “Points of Entry”?
    - Where does George sit?
  - What capability at each point of entry?
    - Be careful of Web Clients
    - Contrast operation versus engineering
  - Impact of the word “Simultaneous”
    - Software has become very modular and licensing concepts have become very complex. Know what you are buying!

Key Quality Issues

- The Enterprise Level
  - Alarm processing
    - Where do alarms go and when do they go there?
    - Who can acknowledge them?
  - Data presentation methodologies
    - Graphics, navigation, data summaries
  - The security structure
  - Data processing and reports
    - Data is just data. Processed data can lead to good decision making.

Key Quality Issues

- Open Systems
  - What is your definition? Think about it!
  - Simple references to the use of systems based on BACNet or LonWorks is a waste of time.
  - Most vendors will use open protocols as a means of locking out competition without adding a great deal of value.
  - Open systems can be achieved but there is a cost at the design phase.

Key Quality Issues

- Key Issues With Open Systems
  - Segmentation of building controls from the enterprise level
  - Capability at each “Point of Entry” with respect to each building control system
  - Incremental work
- Open Systems is a specialty within a specialty. You must get past the marketing and into the details!
- Exciting opportunity. Major challenges.

The People

- There are several key personnel that will make or break the success of a DDC system.
  - Owner's key technical person
  - Designer/consultant
  - Commissioning agent
  - Contractor's project engineer
- Weakness by any of the above typically leads to a system of lower quality

Education & Training

- The investment in a DDC system is for the long term.
- Training on the system is critical to the successful operation of the system.
- Fundamental skills are important. If the PID mathematical model or the concept of a rolling average “does not compute”, you have the wrong person.

Education & Training

- The requirements for training are as important as all of the hardware and software elements of the system.
- Training must be defined, executed and measured against a very well defined list of specific objectives.
- “Deliver 40 hours of operator training” is not a quality specification.

Commissioning

- Starts with design, not after construction
- It is a quality control system that measures the successful implementation of a quality specification.
- It is “hands on”. It is not the validation of paperwork by the contractor.

Commissioning

- Key areas
  - Physical quality of installation
  - Correct I/O
  - Calibration
  - Tuning
  - Functional testing
  - Communication performance
  - Validation of “soft tasks”

Commissioning

- Management Structure
  - Should be independent with respect to the contractor
  - The owner has to provide support on enforcement issues

Continuous Commissioning

- At the design stage of a control system there are many unknowns and resolving them at the design stage is not cost effective.
- A review of performance during the warranty period and down the road will lead to strategy changes and better performance.

Continuous Commissioning

- Review the “macro” level parameters
  - Functional operation of the building
  - Energy consumption for current use
  - Changes in energy cost parameters
- Review energy flows
  - Identify conflicting processes
  - Look for poor control environments that could be rectified with application changes

Continuous Commissioning

- Review the “finesse” issues such as stability and timing.
- Review the data collection and processing
  - Could additional information provide opportunities for better decision making?
- How well is the maintenance program proceeding?

Recommendations

- Improve the “acquisition process”
  - Knowledgeable specifications that describe the important requirements
  - Communicate the requirement for quality
  - Enforce the requirement for quality
- Put together a well trained team
- Embrace commissioning and continuous commissioning.
- It is blocking and tackling that will win.